

Appln. No. 09/228,772
Amendment dated June 1, 2004
Reply to Office Action of March 1, 2004

Listing of Claims:

1. (canceled)
2. (canceled)
3. (previously presented) A robust adaptive filter comprising:
an adaptive filter utilizing a fast converging adaptive algorithm;
means for modifying said algorithm by the application thereto of an
adaptive scaled non-linearity; and

a double talk detector connected to said adaptive filter for disabling said
adaptive filter in response to the detection of double talk on a telephone circuit;

wherein the fast converging algorithm is PNLMS.
4. (previously presented) A robust adaptive filter comprising:
an adaptive filter utilizing a fast converging adaptive algorithm;
means for modifying said algorithm by the application thereto of an
adaptive scaled non-linearity; and

a double talk detector connected to said adaptive filter for disabling said
adaptive filter in response to the detection of double talk on a telephone circuit

wherein the fast converging algorithm is PNLMS++.
5. (previously presented) A robust adaptive filter comprising:

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an adaptive filter utilizing a fast converging adaptive algorithm;
means for modifying said algorithm by the application thereto of an
adaptive scaled non-linearity; and

a double talk detector connected to said adaptive filter for disabling said
adaptive filter in response to the detection of double talk on a telephone circuit;

wherein the fast converging algorithm is APA.

6. (previously presented) A robust adaptive filter comprising:

an adaptive filter utilizing a fast converging adaptive algorithm;
means for modifying said algorithm by the application thereto of an
adaptive scaled non-linearity; and

a double talk detector connected to said adaptive filter for disabling said
adaptive filter in response to the detection of double talk on a telephone circuit;

wherein the fast converging algorithm is PAPA.

7. (previously presented) The filter of claim 3, wherein the adaptive scaled
non-linearity is given by the formula:

$$\Psi\left(\frac{|e_n|}{s}\right) \text{sign}\{e_n\}s_n, \text{ wherein } \Psi \text{ is a hard limiter; and } \left(\frac{|e_n|}{s}\right) \text{ is the mean}$$

error divided by a scale factor; and $\{e_n\}$ is a sample of echo signal; and s_n is a scale factor.

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8. (previously presented) The filter of claim 4, wherein the adaptive scaled non-linearity is given by the formula:

$$\Psi\left(\frac{|e_n|}{s}\right) \text{sign}\{e_n\}s_n, \text{ wherein } \Psi \text{ is a hard limiter; and } \left(\frac{|e_n|}{s}\right) \text{ is the mean}$$

error divided by a scale factor; and $\{e_n\}$ is a sample of echo signal; and s_n is a scale factor.

9. (previously presented) The filter of claim 5, wherein the adaptive scaled non-linearity is given by the formula:

$$\Psi\left(\frac{|e_n|}{s}\right) \text{sign}\{e_n\}s_n, \text{ wherein } \Psi \text{ is a hard limiter; and } \left(\frac{|e_n|}{s}\right) \text{ is the mean}$$

error divided by a scale factor; and $\{e_n\}$ is a sample of echo signal; and s_n is a scale factor.

10. (previously presented) The filter of claim 6, wherein the adaptive scaled non-linearity is given by the formula:

$$\Psi\left(\frac{|e_n|}{s}\right) \text{sign}\{e_n\}s_n, \text{ wherein } \Psi \text{ is a hard limiter; and } \left(\frac{|e_n|}{s}\right) \text{ is the mean}$$

error divided by a scale factor; and $\{e_n\}$ is a sample of echo signal; and s_n is a scale factor.

11. (canceled)

12. (canceled)

13. (previously presented) A robust echo canceller comprising:
 an adaptive filter for outputting an error signal in response to a detected echo signal; and

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means for supplying adaptive filter coefficients to said filter, wherein said filter coefficients are given by the formula: $h_{n+1} = h_n + \frac{\mu}{x_n^T G_n x_n + \delta} G_n x_n \varphi(|e_n|) \text{sign}\{e_n\}$, wherein h_n is the estimated echo path; μ is the overall step size parameter; G_n is the excitation matrix; x_n is the excitation vector; δ is the regularization parameter that prevents division by zero; $|e_n|$ is the mean error; and $\{e_n\}$ is a sample of echo signal.

14. (previously presented) The echo canceller of claim 13, further comprising a double talk detector connected to a telephone circuit for disabling said means for supplying adaptive filter coefficients in response to the detection of double talk on said circuit.

15. (previously presented) A robust echo canceller comprising:
an adaptive filter for outputting an error signal in response to a detected echo signal; and

means for supplying adaptive filter coefficients to said filter, wherein said filter coefficients are given by the formula: $h_{n+1} = h_n + \mu G_n X_n R_{xx}^{-1}(n) [\varphi(|e_n|) \otimes \text{sign}(e_n)]$, wherein h_n is the estimated echo path; μ is the overall step size parameter; G_n is the step-size matrix; X_n is the excitation matrix; R_{xx}^{-1} is the correlation matrix; $|e_n|$ is the mean error; \otimes denotes elementwise multiplications; and $\{e_n\}$ is a sample of echo signal.

16. (previously presented) The echo canceller of claim 15, further comprising a double talk detector connected to a telephone circuit for disabling said means for supplying adaptive filter coefficients in response to the detection of double talk on said circuit.